SEDRIS: Does it make sense as a model for HBR?

June 19, 2001

Topics

- What is SEDRIS - a quick overview
- How & when did we start (motivation and timing)
- Small team, big ideas
- Technical challenges, business challenges
- The tough problems
- Key milestones through the years
- SEDRIS today
- Issues in human behavior representation and modeling
- What lessons can be used

Primary Aspects of SEDRIS (technical)

- ***An infrastructure technology for expressing and sharing environmental data***
- ***Unambiguous representation of environmental data***
  - **Semantics and relationships of data elements**
  - **All environmental domains**
  - **Expressed in a data representation model**
- ***Efficient interchange of environmental data***
  - **Sharing and re-use**
  - **Ease of access and software development (API)**
  - **Tools and applications**

Technical Objectives

- ***Articulate and capture the complete set of data elements and associated relationships needed to fully represent environmental data***
  - **Data Representation Model (DRM)**
  - **Environmental Data Coding Specification (EDCS)**
  - **Spatial Reference Model (SRM)**
- ***Provide a standard interchange mechanism to pre-distribute environmental data and promote database reuse among heterogeneous applications***
  - **Software interface specification (API)**
  - **SEDRIS Transmittal Format (STF)**
- ***Support the full range of applications across all environmental domains (terrain, ocean, atmosphere, and space) and 3-D models***

Technology Components of SEDRIS

- *Data Representation Model (DRM):* **Provides syntax and structural semantics for representing environmental data and databases (the "grammar" of the language)**
- *Environmental Data Coding Specification (EDCS):* **Provides "thing" level semantics (the dictionary of the language) (classify/attribute scheme)**
- *Spatial Reference Model (SRM):* **Unified and robust description of the spatial reference systems (coordinate systems), along with an accurate, efficient, and fast software implementation**
- *Software Interface Specification:* **(Read and Write Application Programmer Interfaces (APIs))**
  - **Allows ease of access**
  - **Lowers the barrier-to-entry in software development**
- *SEDRIS Transmittal Format (STF)*: **Platform independent storage and transmission of data**

Primary Aspects of SEDRIS (business)

- *A technology base for reducing data access cost, saving development cost, and improving business efficiency*
- *A platform for leveraging existing products, value-adding and accessing current data sets, creating new products, or building on the core technologies*
- *A structured method for describing and communicating environmental data requirements/needs*
- *A community and an open forum for exchanging and sharing ideas and concepts*
- *Promoting innovation and business growth through open standards*

Business Objectives

- ***Enable and promote interoperability***
- ***Shift the business focus from "competing to dominate based on infrastructure" to "competing to provide the best value-added or most cost-effective content"***
- ***Expand the commercial business base by providing innovative and practical solutions***
- ***Support existing projects and applications through reuse***
- ***Offer solutions only when there is a clear gain***

How SEDRIS Technologies are Applied

Use:

- ***the DRM*** **to model environmental data**
- ***the DRM, EDCS, and the SRM*** **to specify environmental database content**
- ***the EDCS*** **as a stand alone component**
- ***the SRM*** **as a stand alone component**
- ***all SEDRIS technology components*** **as an interchange mechanism**
- ***SEDRIS tools*** **to examine environmental data**
- ***SEDRIS Technologies*** **as a base to develop new tools**

The Conditions - The Motivation

- Very high database development costs
- Database reuse costs in several hundred thousands
- No support for expressing semantics - highly visual system driven
- Database reuse non-existent in practice
- Interoperability of networked systems costly and nearly impossible to achieve - environmental database creation and interchange a large source of problems
- Industry not motivated to take action
- Past efforts to rectify the situation only partially successful
- Efforts to energize existing projects or industry to take on the task failed

Timing

- Early 90's: based on 80's experience, high potential and promise for use of heterogeneous networked systems
- Nearly two years of effort to expand existing projects to take on ("own") and solve the problem
- The idea for "SEDRIS" initiated in May 1994, work began in September '94
- In response to interchange deficiencies faced by STRICOM and DARPA's projects
- Started as an effort to "fix" data interchange problem so we can then focus on interoperability
- Initially envisioned as a few person-months of effort over a few calendar months!

Small team, big ideas

- A team of six experienced engineers
  - Database, visual, SAF, vehicle simulation, & systems engineers
- Based on a philosophy of practical solutions built on solid technologies and iterative design
- Established guiding principals for development
- Balance between practicality and elegance
- Focus on core design first, dress it up later
- Content before form (or process)
- Favor no domain or application over any other
- Emphasize important but neglected business areas
- Recognize the need for expertise from outside

Technical Challenges

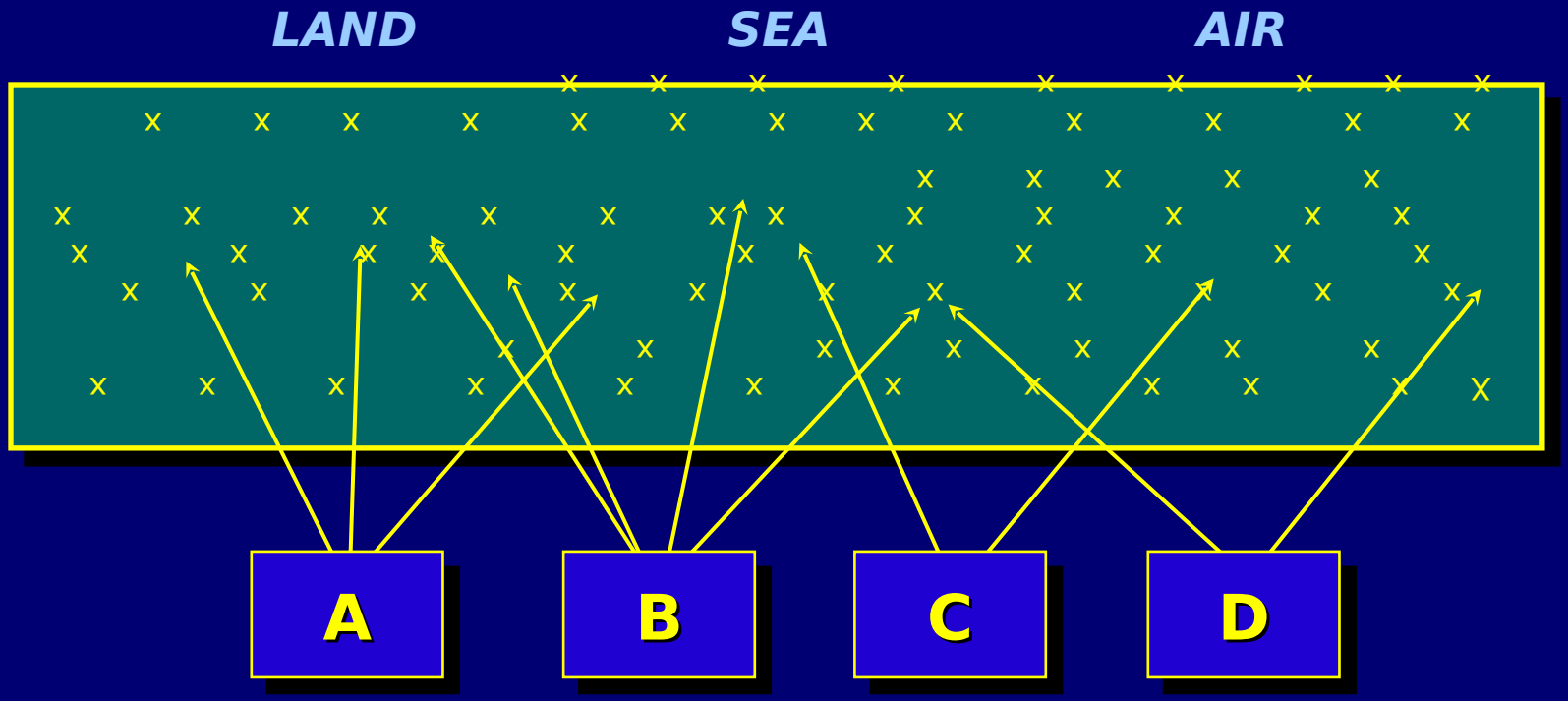
- Can there be one model that accommodates many
- Generalize the result to tackle similar problems, but stay specific enough so users can find their solutions
- Must stay practical - size, speed, efficiency
- Full blown semantics cannot be mandatory, but highly encouraged (through business incentives)
- Design solutions beyond state of the art, 5-10 years
- Cover all the domains of environment
- Support all classes of applications
- Establish a foundation that can be grown without requiring to be rebuilt
- Provide software tools to reduce effort

Business Challenges

- Is it ready for a test drive?!
- Have we thought about (but not done) all the issues - is there a home for different business areas?
- Who knows the requirements? Everybody is in charge!
- Industry vs. government
- How to get buy-in from (a CPFF) industry!
- Market size and volunteer participation (incentives)
- Where do we get the money?!
- Seeding the community
- Changing an established mind set
- Maximum return on minimal investment
- Who cares about infrastructure technologies

Tackling the Requirements Problem

Very large number of users with both common & unique requi



Agencies or companies that produce environmental datab

The Key: ***Small number of environmental database builders***

(in contrast to environmental data

The Tough Problems

Business

- *Get a total set of requirements*
- *Keep commercial processes and proprietary products involved but maintain an open exchange mechanism*

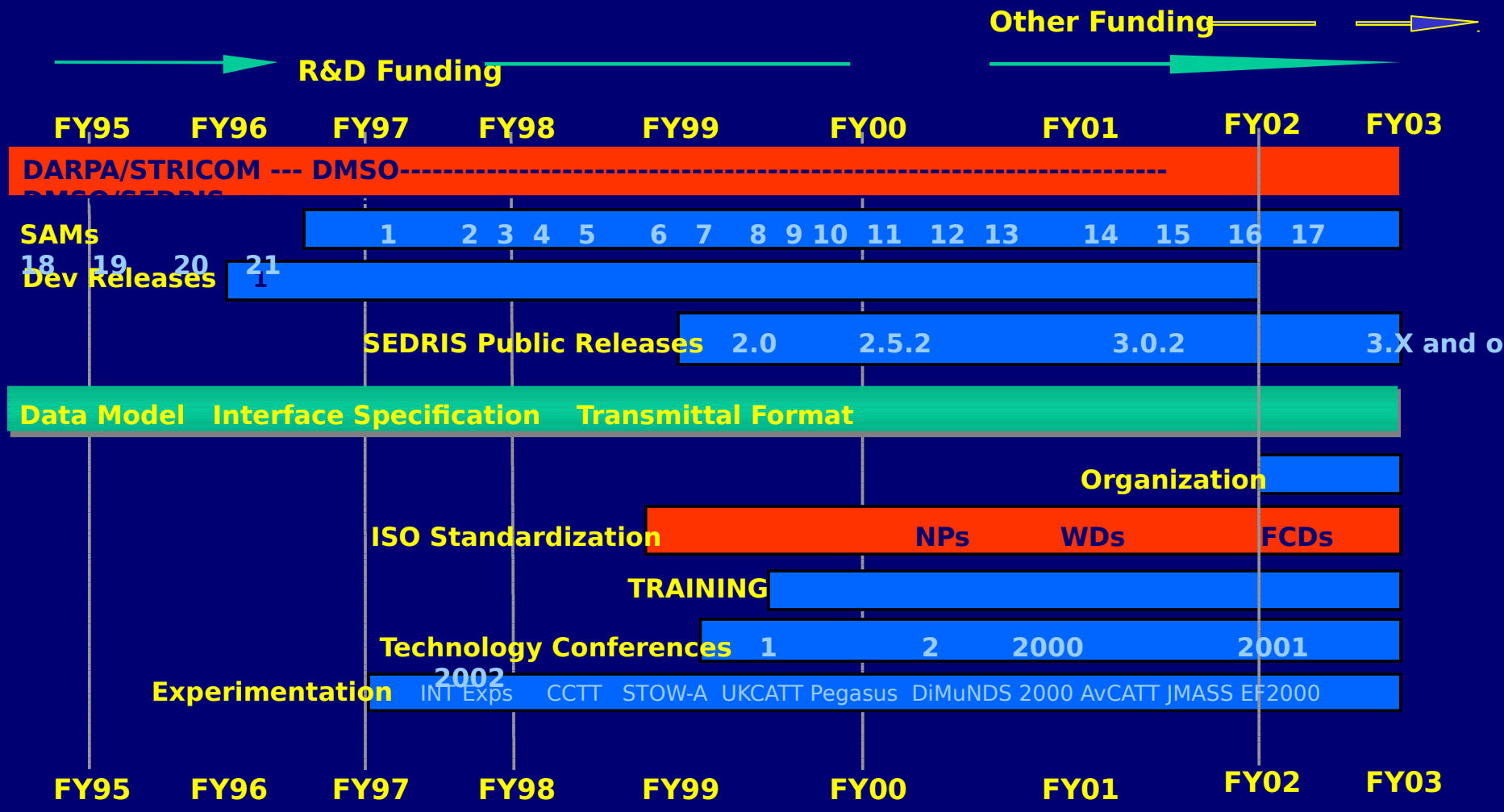
Technical

- *Different views of the environment*
  - **Air, land, sea, space**
  - **Spatial location and orientation (coordinate system and datum)**
- *Lack of underlying environmental framework*
  - **No integrated reference model available**
    - **Representation**
    - **Naming/semantics**
  - **Existing Data Models are conceptual, future models which are non-integrated and don't address current data repositories and data interchange requirements**

Commercial Process Issues

- ***Proprietary products (are not bad)***
- ***Open exchange* (same place) required for interoperability**
- ***Value-added tools and utilities* for small product volume**

The Development Timeline



Within the first nine months…

- Developed the core technology (data representation model) using a small, focused team of experts
- Addressing terrain, atmosphere, and ocean domains
- Unified and articulated the basics of environmental data requirements
- Refined it based on feedback
- Involved the community and key M&S vendors and data providers
  - Seeded the community by targeting industry partners
  - Briefed the community at industry conferences
- Started the project move to DMSO
- Began expanding the core team

Within 18 months …

- Solicited and selected industry participation through a STRICOM BAA Process
- Established an integrated management team
- Migrated to an object oriented DRM
- Implemented, iterated, & evolved software prototypes
- Web site and internal e-mail lists established
- Outreach (DIS/SIW, I/ITSEC, program briefs, …)
- Began verification of the DRM through small interchange experiments, conversions, and tools
  - Terrain features (VPF data)
  - 3D models/icons
- Initial assessment of possible formats

Within 36 months ...

- Engaged in development through many SEDRIS Associates (and associate meetings (SAMs))
- Refined the DRM and the API
- Completed the design of the format
- Verification through more interchange experiments
- New tools and conversion applications generated
- Outreach (I/ITSEC, DMSO Industry Days, SIW, OGC, ...)
- Technology insertion to other programs (WARSIM, JSIMS)
- Began spinning off EDCS & SRM as independent pieces
- Began looking into standardization efforts
- Tools ... and more tools ...

SEDRIS Today: Mature Technologies

- Focus on standardization and market development
- Develop and conduct more training (Education)
- Establish certification & compliance testing processes
- Expand the marketplace through focused experiments and exercise involvement (Outreach)
- Maintain and configuration manage the interchange mechanism (Infrastructure Support & Sustainment)
- Monitor customer satisfaction
- Implement approved changes based on operational use

Standards Development Objectives

- *Document technologies* as recognized standards
- *Obtain review, and feedback*, from the broader international community
- *Establish international standards*
- *Promote software implementations:*
  - Software library for the Spatial Reference Model (SRM)
  - Data dictionary database and mapping software for the Environmental Data Coding Specification (EDCS)

ISO / IEC Standards

- **18023:** ***SEDRIS*** **– multi-part -**
  - ***Part 1: SEDRIS Functional Specification*** **(includes the Data Representation Model and the Interface Specification)**
  - ***Part 2: SEDRIS Transmittal Format***
  - ***Part 3: SEDRIS Transmittal Format Binary Encoding***
- **18024:** ***SEDRIS Language Bindings*** **– multi-part, initially -**
  Part 4: SEDRIS Language Binding to ISO C
- **18025:** ***Environmental Data Coding Specification (EDCS)***
- **18026:** ***Spatial Reference Model (SRM)***
- **18041:** ***EDCS Language Bindings*** **– multi-part, initially -**
  Part 4: EDCS Language Binding to ISO C
- **18042:** ***SRM Language Bindings*** **– multi-part, initially -**
  Part 4: SRM Language Binding to ISO C

Participating in ISO / IEC Standards

- **SEDRIS standards work assigned to *Joint Technical Committee 1 (JTC1) Sub-Committee 24 (SC 24) (Computer Graphics and Image Processing)***
- **SC 24 established *Working Group 8 (WG 8) (Environmental Representation):* SEDRIS work started October 1999**
- **ISO / IEC standards development steps: *Working Draft (WD), Committee Draft (CD), Final Committee Draft (FCD), Draft International Standard (DIS), International Standard (IS)***
- **National standards development organizations represent member countries in the ISO / IEC standards development, review, and voting process**
- **One vote per member country**
- **For more information see the following web sites:**
  - ***http://www.iso.ch***
  - ***http://www.jtc1.org***
  - ***http://www.bsi.org.uk/sc24***
  - ***http://www.sedris.org/wg8home***

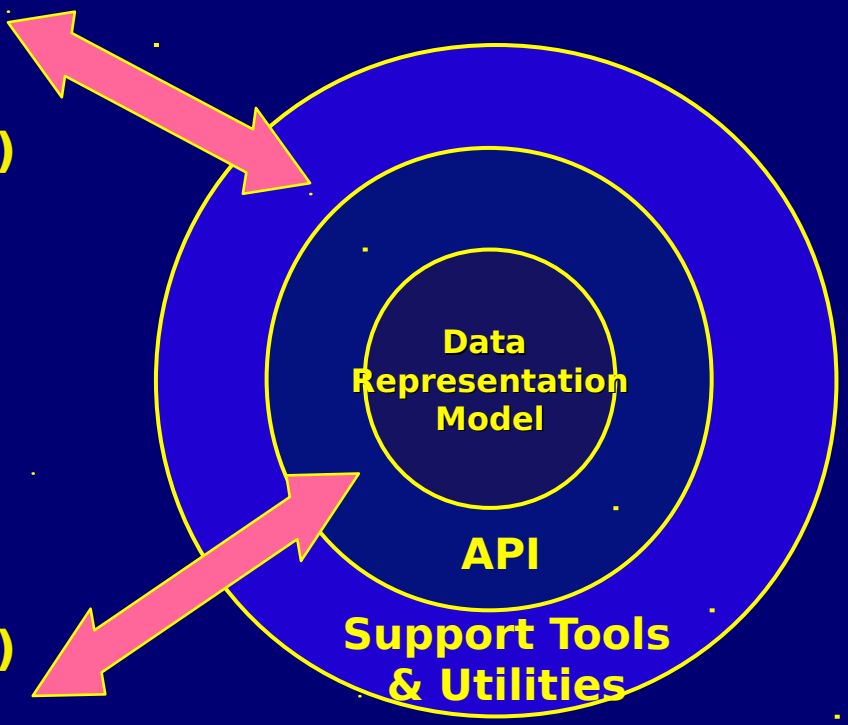
Other Standards Activities

- ***Simulation Interoperability Standards Organization (SISO)*** **has established product development groups (PDG) to** ***review, promote, and establish SEDRIS -developed technologies as SISO guidance and / or reference products***
- **PDGs working on EDCS and SRM to:**
  - **Review and input to ISO / IEC standards for EDCS and SRM**
  - **Adopt existing, and develop new, technical implementations of EDCS and SRM as SISO products**
- **For more information on SISO PDG activities visit the SISO web site at:** ***http://www.sisostds.org***

How the Pieces fit Together

Associates and Core Team Roles

- ***SEDRIS Associates*** **(key environmental database developers/users)**
  - **Review and feedback**
    - **Data Representation Model**
    - **Interface Specification (API)**
  - **Native-model mapping**
  - **Interchange experiments**
  - **Value-added tools/utilities**
- ***Core Team***
  - **Manage evolution**
    - **Data Representation Model**
    - **Interface Specification (API)**
  - **Reference implementation(s)**
  - **Transmittal Format**
  - **Common tools & applications**



Industry Associate Developers ...

- *AcuSoft, Inc.*
- *STN ATLAS Elektronik GmbH*
- *Boeing*
- *Charles River Analytics, Inc. (CRA)*
- *Curl Corporation*
- *Cybernet Systems Corporation*
- *ERDAS*
- *Evans and Sutherland (E&S)*
- *JRM Enterprises, Inc.*
- *Indra*
- *L3 Communications - Link Simulation & Training*
- *Lockheed Martin Information Systems (LMIS)*
- *Lockheed Martin Tactical Defense Systems (LMTDS)*
- *Logicon-TASC*
- *MultiGen - Paradigm Inc. (MPI)*
- *Northrup Grumman*
- *Oktal*
- *Netherlands Organization for Applied Scientific Research (TNO)*
- *ProLogic*
- *Raytheon Systems Company*
- *Raytheon Training Systems*
- *Reality By Design Government Systems, LLC (RBD)*
- *Science Applications International Corporation (SAIC)*
- *SGI*
- *Soft Reality, Inc.*
- *SOGITEC*
- *TerraSim*
- *TerrEx*
- *Thales Training & Simulation (TT&S)*
- *VCOM3D, Inc.*

More Associate Implementers

Government

- *U.S. Army Training and Doctrine Command (TRADOC) Mounted Maneuver Battlespace Battle Lab (MMBL) - Ft. Knox*
- *U.S. Army Communications Electronics Command (CECOM) Night Vision & Electronic Sensors Directorate (NVESD) - Ft. Belvoir*
- *U.S. Naval Surface Warfare Center - Dahlgren Division*
- *U.S. Joint Warfare System (JWARS) Joint Program Office / CACI*

Academic

- *University of Central Florida - Institute for Simulation and Training (UCF - IST)*

Other Participating Organizations

- *Arteon, Inc.*
- *BVR Systems Ltd. (Israel)*
- *Defense Threat Reduction Agency (DTRA)*
- *Institute for Defense Analyses (IDA)*
- *The MITRE Corporation*
- *Logicon Sterling Software, Inc.*
- *National Aeronautics and Space Administration (NASA)*
- *National Imagery and Mapping Agency (NIMA)*
- *Naval Air Warfare Center Training Systems Division (NAWC / TSD)*
- *Naval Oceanographic Office (NAVOCEANO)*
- *Naval Research Laboratory (NRL)*
- *SRI International*
- *U.S. Air Force Combat Climatology Center (AFCCC)*
- *U.S. Army Engineer Research and Development Command (ERDC) Topographic Engineering Center (TEC)*
- *U.S. Army Simulation Training and Instrumentation Command (STRICOM)*

Supporting Organizations & Programs

- *AEgis Technologies Group, Inc.*
- *Armed Forces Training Systems, Inc. (AFTS)*
- *Combined Arms Tactical Trainers (CATT)*
- *Defense Advanced Research Projects Agency (DARPA)*
- *Defense Modeling and Simulation Office (DMSO)*
- *Distributed Simulation Technology, Inc. (DiSTI)*
- *Joint Modeling & Simulation System, Joint Program Office (JMASS / JPO)*
- *Joint Simulation System, Joint Program Office (JSIMS/JPO)*
- *Joint Strike Fighter, Joint Program Office (JSF / JPO)*
- *Quantum Research International*
- *U.K. Combined Arms Tactical Trainer (UKCATT)*
- *U.S. Air Force Weather Agency (AFWA)*
- *U.S. Army Model and Simulation Office (AMSO)*
- *Virtual Emergency Response Training System (VERTS)*

… other Participants / Contributors

- **Government Organizations:**
  - *Defence Science and Technical Laboratory (DSTL) (United Kingdom)*
  - *Defence Science and Technology Organisation (DSTO) (Australia)*
  - *Netherlands Organization for Applied Scientific Research (TNO) (Netherlands)*
  - *Defence Research Establishment (Sweden)*
  - *Ministry of Defence (MoD) (Singapore)*
  - *NATO Command, Control, and Consultative Agency (NC3A)*
- **International Membership Organizations:**
  - *ISO and ISO / IEC Technical Committees and Sub-Committees*
  - *Open Geographic Information Systems (GIS) Consortium (OGC)*
  - *Digital Geographic Information Working Group (DGIWG)*
  - *Simulation Interoperability Standards Organization (SISO)*
  - *NATO (M&S Coordination Office, M&S Group, and Armaments Groups)*

Associate Responsibilities

- Learn to "speak" SEDRIS (the data representation model)
- Monitor and participate in SEDRIS e-mail discussions
- Participate in SEDRIS Associate Meetings (as needed)
- Contribute to the state of the art in SEDRIS
- Provide feedback on SEDRIS technologies
- Educate other SEDRIS team members on their domain-specific issues and topics
- Develop "mapping documents" between their native format (if any) and SEDRIS
- Develop conversion software between their native format (if any) and SEDRIS
- Validate their conversion software (if any) by conducting comparison experiments
- Develop tools, utilities, or applications (as applicable)
- Cooperate and collaborate with other associates on projects of mutual benefit
- Promote SEDRIS and its use

Benefits of being an Associate

- Direct access to advance information on upcoming SEDRIS version additions, changes, or modifications.
- Benefit from interim releases of core technologies that can be used in early prototyping, advance product integration, or inclusion in project-specific milestones prior to the next formal release.
- Access to other associates' software that is releasable and of mutual value.
- Access to prototypes, tools, utilities, converters, and other applications.
- Interaction with others actively working on SEDRIS, including core team members.
- Opportunity to influence and shape the core SEDRIS technologies.

How to become an Associate

- **Associate status is granted by the SEDRIS Management Team based on evaluation of the responses to the following questions.**
  - **What is the interest in becoming an associate?**
  - **What value is SEDRIS expected to provide the associate?**
  - **What benefit(s) will the associate offer SEDRIS?**
  - **What funding resources are expected to cover the associate's work?**
  - **Who are the primary points of contact and expected performers?**
  - **How long after start is the associate expecting to remain an active participant?**
- **The answer to these questions, in the form of a short white paper or proposal, along with any other pertinent information should be sent to: se-mgmt@sedris.org.**

Recap

- *An unambiguous representation of environmental data*
  - Semantics and relationships of data elements
    - Expressed in a data representation model, with an
    - Associated data coding specification
  - All environmental domains
- *An efficient interchange of environmental data*
  - Promotes sharing and re-use
  - Ease of access and software development (API)
  - Tools and applications
- *Undergoing international standardization*
  (Your participation is Welcome!)
- *Currently in use, rigorously tested*
- *Powerful representational and interchange technology*
- *Enabling businesses to succeed and grow*

Performance Measures

- Greater number of accessible databases
- More rapid, cost effective access to databases
- Lower development costs through greater reuse
- Increased capability to facilitate rapid response requirements
- Lower life cycle management costs
- Incorporation of the SEDRIS concepts and technology in commercial products
- Agency letters stating adoption of SEDRIS as a way of doing business
- Government stated SEDRIS requirement
- Increase in number of contractors using SEDRIS as a data exchange format
- Monitor customer satisfaction
- MSRR, MEL, etc. requests for SEDRIS as a format for data exchange
- Positive customer feedback through web page and/or surveys

Issues to Consider in Human Behavior Representation / Modeling

- What is the size of the market for human behavior modeling?
- Who are the dominant players?
- What problems are currently faced by the community dealing with human behavior modeling (what is the exact motivation)?
- Separating human behavior representation, human behavior modeling, and human behavior
- Is the separation between models that create or use behavior and “behavior data sets” (e.g. initial conditions, behaviors over a certain time, behavior “animation” (predefined series/sequences of actions)) practiced or at least clear in industry?

Issues to Consider in Human Behavior Representation / Modeling (cont')

- What does it mean to have "human behavior data" (vs. algorithm)? Is this data "after the fact"?
- What "human behavior data sets" would one share?
- Are there tools or established processes for creating "human behavior data"? Should there be? What should be their requirements for input and output?
- How can/will such new technology be applied to other broader (non-military M&S) business areas? How does aggregate behavior (group, herd) differ from organization behavior, vs. organized behavior?
- Will the development of these technology be limited to military domain? Will technology development be separated from business niche?
- Don't decision making models (optimized or not) go hand in hand with behavior modeling (2nd and 3rd initiatives for FYxx)?
- …

What lessons can be used…

- Don’t worry about money!
- Focus on business AND technical needs
- Treat it as product development (life cycle, marketing, engineering, testing, sales, training, evolution, …)
- Start with a small team of …
- Establish some guiding axioms
- Worry more about content than process at this stage
- Produce fundamental and strong solutions first
- Keep it practical, but tend to systems engineering too
- Pick a name around then (but be careful, names do last)
- Open it for broader review based on initial strong product
- Document your products
- Involve industry, provide incentives
- Add more (people and technology) to the mix
- Manage the growth (stir carefully), and market appropriately
- Plan for handing it off to industry

Back up / Extra charts

Definitions

- OED: Behavior - way of behaving
- OED: Behave - act or react in a specified way
- “Human Behavior” -
  - Actions, in a given context or situation, that result from processing emotions and reasoning based on reactions to (human) sensory inputs, and are combined with past experiences